Asian Journal of
Science, Technology, Engineering, and Art

e-ISSN: 3025-4507
p-ISSN: 3025-5287
Index: Harvard, Boston, Sydney University, Dimensions, Lens, Scilit, Semantic, Google, etc

https://doi.org/10.58578/AJSTEA.v4i1.8130

Performance Evaluation of a Rotary Paddy Power Weeder

Muhammed Ibrahim Binni[1], Abdulwahab M.[2], Ishaya Genesis[3], Zago Salisu Idris[4]
[1,3,4]Federal University Wukari, Taraba State, Nigeria
[2]Sule Lamido University Kafin Hausa, Jigawa State, Nigeria
ibmuhammed.age@fuwukari.edu.ng

Article Info:

Submitted:	**Revised:**	**Accepted:**	**Published:**
Dec 1, 2025	Feb 2, 2026	Feb 16, 2026	Feb 21, 2026

Abstract

Weed infestation in paddy cultivation substantially constrains yield and profitability, especially where reliance on manual weeding remains time-consuming and costly. This study evaluates the performance of a rotary paddy power weeder powered by a 1.75 hp two-stroke petrol engine under wetland conditions, focusing on operational efficiency and economic feasibility. Field experiments were conducted at three forward speeds (1.58, 1.92, and 2.34 km/h) to assess weeding efficiency, plant damage, field capacity, fuel consumption, and post-weeding weed re-emergence. The results show that an intermediate forward speed of 1.92 km/h produced the best overall performance, achieving a weeding efficiency of 72.38% with minimal crop injury. Higher speeds increased field capacity but also elevated fuel consumption and reduced weeding quality, as the moving blades lacked sufficient dwell time for complete weed cutting. Cost analysis demonstrated that mechanized weeding with the rotary power weeder markedly reduced labor requirements and lowered weeding costs by approximately Rs. 2265 per hectare compared with manual methods. These findings indicate that rotary paddy power weeders offer a sustainable and economically viable alternative to manual weeding in paddy fields, supporting improved weed management and farm profitability.

AJSTEA Journal is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License

Keywords: Rotary Paddy Power Weeder; Weed Control; Weeding Efficiency; Field Capacity; Mechanization.

Introduction

Weeds represent one of the most critical challenges in paddy cultivation, often decreasing yield by increasing competition for nutrients, sunlight, and water. In traditional paddy production systems, manual weeding constitutes a significant portion of the labor input and contributes to rising production costs. Furthermore, chemical herbicides, while effective in the short term, pose serious environmental, health, and sustainability concerns. As a result, contemporary agricultural research is focused on mechanized solutions that address these issues while providing effective weed control.

More studies focused on optimizing the mechanical design of rotary weeders through adjustments in blade arrangement, angular settings, and overall geometry. Studies by Mandal et al. (2013), Bhosale et al. (2017), and Khayer et al. (2022) have shown that innovative blade configurations can significantly improve the cutting efficiency of these devices under various soil conditions. In addition, several comparative studies indicate that while manual weeding may provide immediate weed removal, it is neither sustainable nor ergonomically favorable over the long term. Mechanized weeders, by contrast, offer additional benefits such as improved soil aeration and reduced reliance on chemical inputs, which are crucial for the long-term sustainability of paddy production.

Recent studies have highlighted the benefits of rotary power weeders as a nonchemical alternative for weed management. For instance, Ragesh et al. (2018) reported that modified power weeders operate efficiently at specific speeds, while Kadam et al. (2019) and Tayade & Sahu (2020) demonstrated that such implements can reduce energy and labor costs, despite differences between various systems. Mechanized weeders not only uproot weeds more effectively by cutting at the root, rather than merely slicing them, but also contribute to soil aeration, which improves water penetration and nutrient uptake. Simultaneously, finding an optimal operational speed is critical. Speeds that are too low may not provide sufficient cutting action, while those that are too high can lead to inefficient weeding and significant crop damage, Pullen et al. (1997).

The paper presents a comprehensive performance evaluation of a rotary paddy power weeder. By integrating the findings with those from contemporary studies, we aimed to provide a robust discussion on the trade-offs between operational speed, fuel consumption, crop safety, and economic efficiency. In doing so, the study ultimately reinforces the argument for adopting mechanized weed control systems in paddy fields.

Materials and Methods

Machine Description

The Paddy Power weeder evaluated in this study is a lightweight implement powered by a 1.75-hp two-stroke petrol engine with a capacity of 2 liters (oil capacity included). The engine power is transmitted via an oil-lubricated gearbox to dual rotary discs, with each disc sporting four staggered blades. An adjustable blade mechanism allows the operator to adapt the implement to the specific row spacing of paddy crops, providing an effective cutting width of approximately 150 mm. Safety is ensured by a protective mud guard covering the blade assembly to prevent debris from injuring the operator.

Experimental Setup

Field experiments were conducted in a paddy field in the Allahabad region under typical wetland conditions. The crop, 38 days old and with an average population of around 35 plants per m^2 (row spacing ca. 30 cm), was subjected to weeding trials at three set forward speeds:

- **1.58 km/h**
- **1.92 km/h**
- **2.34 km/h**

Each speed trial was replicated three times on similar plots. The following performance parameters were measured:

- **Weeding Efficiency:** Computed as the percentage reduction in weed density (weeds per m^2) before weeding and 10 days afterward.
- **Plant Damage:** Quantified as the percentage of crop plants injured during the weeding operation.

- **Field Capacity:** Calculated as the actual area (ha/h) covered during operation, accounting for turning and nonproductive time.
- **Fuel Consumption:** Measured in liters per hour (l/h) at different speeds.
- **Weed Re-re-emergence:** Weed counts were recorded 10 days post-weeding to evaluate regrowth in comparison with manual methods.

A one-way ANOVA was used to analyze the significance of different speeds on each parameter at a 5% level of significance.

Results

Weeding Efficiency

Weeding efficiency increased from 63.34% at 1.58 km/h to a maximum of 72.38% at 1.92 km/h. At 2.34 km/h, a slight decline in efficiency (70.69%) was observed, which is attributed to the decreased dwell time of the blades, leading to incomplete weed cutting.

Table 1. Weeding Efficiency at Different Speeds

Speed (km/h)	Weeding Efficiency (%)
1.58	63.34
1.92	72.38
2.34	70.69

Plant Damage

Plant damage was minimal at 1.58 km/h (approximately 1.25 injured plants per 26 m), while damage increased progressively to 2.56 per 26 m at 2.34 km/h. This trend highlights the challenge of controlling the implement at higher speeds, especially in narrow row configurations.

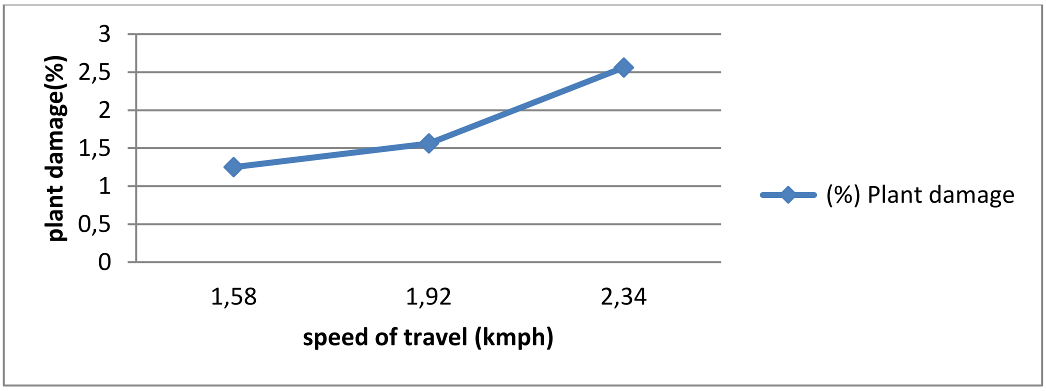

Figure 1. Graph showing the progressive increase in plant damage as forward speed increases.

Field Capacity

Actual field capacity progressively increased with speed: 0.079 ha/h at 1.58 km/h, 0.088 ha/h at 1.92 km/h, and 0.110 ha/h at 2.34 km/h. However, gains in capacity at higher speeds are offset by increased fuel consumption and reduced weeding effectiveness.

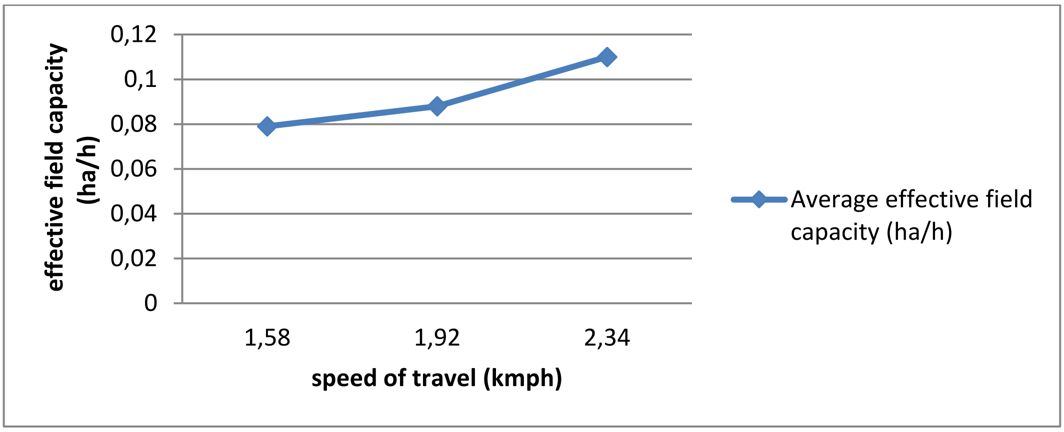

Figure 2. A graph showing the relationship between forward speed and field capacity.

Fuel Consumption

Fuel consumption displayed a rising trend with increased speed: 1.0 l/h at 1.58 km/h, 1.18 l/h at 1.92 km/h, and 1.56 l/h at 2.34 km/h.

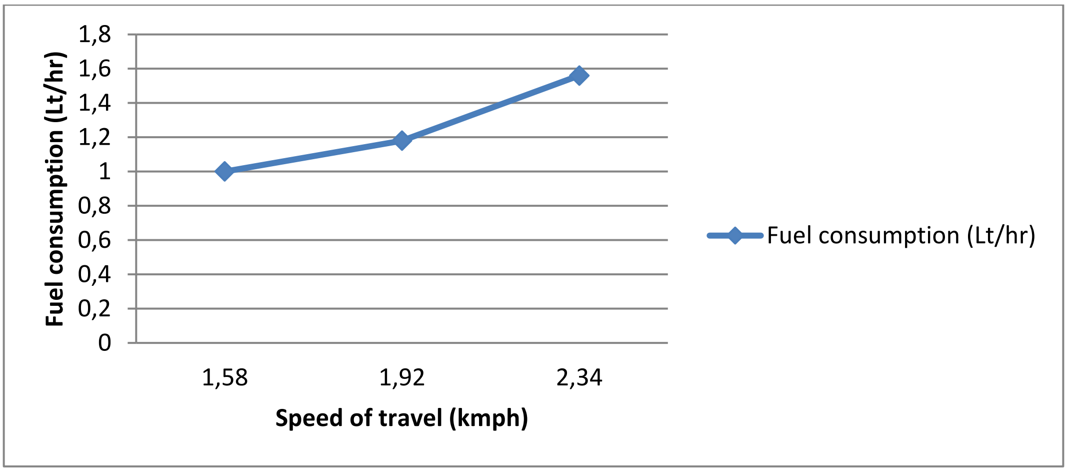

Figure 3. A graph depicting the fuel consumption versus forward speed.

Weed Re-emergence and Economic Analysis

The assessment of weed re-emergence 10 days after weeding showed a lower weed count in plots treated with the rotary power weeder compared to those managed by manual methods. Economic analysis indicated that manual weeding required approximately 200 man-hours per hectare (costing ca. Rs. 6300) versus roughly 11.36 man-hours per hectare (costing ca. Rs. 4035) with the power weeder. This translates to a saving of about Rs. 2265 per hectare.

Discussion

The result aligns well with similar investigations by Ragesh et al. (2018) and Kadam et al. (2019), which consistently exhibited an optimal speed range close to 1.9 km/h for maximizing weeding efficiency in paddy fields. At this speed, the rotary blades engage sufficiently with the weed matrix to achieve deep cutting and root disruption, which is critical for reducing weed re-growth.

In our study, while increasing the speed beyond 1.92 km/h marginally improved field capacity, this came at the cost of heightened fuel consumption and increased plant damage. This trade-off is corroborated by findings by Mohler et al. (2001) that suggest the reduced dwell time at higher speeds results in incomplete uprooting of weeds and potential crop injury. Moreover, other studies have also shown that while the theoretical field capacity increases linearly with speed, the actual benefits are tempered by nonproductive time and control challenges during turns.

Economic assessments further endorse the utilization of mechanical weeders. For example, Tayade and Sahu (2020) noted significant cost savings in labor and time that are comparable to our estimate of Rs. 2265 savings per hectare when compared to manual weeding. These advantages are critical for areas where labor shortages and rising wage rates make traditional methods unsustainable. In addition, the environmental benefits of mechanical weeders by eliminating or greatly reducing the dependency on chemical herbicides are in line with sustainable agricultural practices and organic rice production, which are gaining policy support in many regions.

Lastly, the reduction in weed re-emergence observed in our study further validates the technical merit of the rotary design. Since many mechanically operated systems cut weeds at or below the root level, they contribute to a long-term decrease in weed density. This observation enhances the overall agronomic benefits and sustainability of using such mechanized devices in integrated weed management systems.

Conclusions

1. **Optimal Speed:** An operating speed of 1.92 km/h is optimal, providing a balance between high weeding efficiency (72.38%) and minimal crop injury.

2. **Trade-offs:** While increasing speed yields higher field capacity, it also results in increased fuel consumption and crop damage.

3. **Economic Efficiency:** The mechanized approach offers significant economic advantages, reducing labor input and cutting weeding costs by approximately Rs. 2265 per hectare relative to manual weeding.

4. **Sustainable Weed Management:** The effective root-level weed removal minimizes subsequent weed re-emergence, aligning with sustainable and organic production practices.

5. **Consistency with Literature:** The results are consistent with independent studies that highlight similar optimum operational parameters and economic benefits, thereby reinforcing the potential for widespread adoption of rotary power weeders.

References

Kadam, D. M., Shrivastava, A. K., Deshmukh, G., Kumar, A., Chethan, C. R., Nandini, Y., & Singh, I. (2019). Evaluation of power weeder and comparative study with manually operated rotary weeders and manual weeding method. *Journal of Pharmacognosy and Phytochemistry, 8*(5), 2528–2533.

Khayer, S. M., & Patel, T. (2022). Response surface design optimization for blade geometry of non-rotary push-pull type weeder. *Research Journal of Agricultural Sciences: An International Journal, 13*(4), 1079–1086.

Mandal, S. K., Bhattacharya, B., & Mukherjee, S. (2013). Optimization of design parameters for rotary tiller's blade. *Power, 4*(5).

Mohler, C. L. (2001). Mechanical management of weeds. In M. Liebman, C. L. Mohler, & C. P. Staver (Eds.), *Ecological management of agricultural weeds* (pp. 139–209). Cambridge University Press.

Pullen, D. W. M., & Cowell, P. A. (1997). An evaluation of the performance of mechanical weeding mechanisms for use in high-speed inter-row weeding of arable crops. *Journal of Agricultural Engineering Research, 67*(1), 27–34. https://doi.org/10.1006/jaer.1997.0148

Ragesh, K. T., Jogdand, S. V., & Victor, V. M. (2018). Field performance evaluation of power weeder for paddy crop. *Current Agriculture Research Journal, 6*(3), 441–448. https://doi.org/10.12944/CARJ.6.3.24

Tayade, N. H., & Sahu, B. (2020). Performance evaluation of power weeder for paddy crop. *International Journal of Current Microbiology and Applied Sciences, 9*(2), 2291–2295. https://doi.org/10.20546/ijcmas.2020.902.259